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October 30, 1990

BY MESSENGER

Ms. Mary T. Smith
Director
Field Operations and Support Division
EN-397F
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Public Docket No. A-90-16

Dear Ms. Smith:

The U.S. EPA just in the last week placed in the above-captioned docket the results of particulate testing conducted by its Mobile Vehicles Emissions Laboratory in Ann Arbor, Michigan.[1/] Based on these results, certain EPA staff members have evidently expressed concern regarding potential particulate matter emission increases associated with use of HiTEC® 3000 ("the Additive") in unleaded gasoline.[2/] For the reasons

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1/ See Memorandum from David Kortum, Environmental Engineer, U.S. EPA to the Air Docket, docket entry IV-E-7 (October 22, 1990).

2/ See Inside EPA (October 26, 1990), at 3; New Fuel Report (October 29, 1990), at 3. While the nature of EPA's concern about particulate emissions has apparently been leaked to the press, no one from EPA has directly explained to Ethyl the nature of the concern about particulates, if any.

described below, Ethyl Corporation ("Ethyl") believes that this concern is unfounded.

I. THE LEGAL STANDARD

Under the Clean Air Act ("CAA" or "Act"), an applicant for a fuel additive waiver must show that use of the additive

> will not cause or contribute to a failure of any emission control device or system (over the useful life of any vehicle in which such device or system is used) to achieve compliance by the vehicle with the emission standards with respect to which it has been certified [under the Act].

CAA § 211(f)(4)(emphasis added). The only emission standards which apply to the certification of gasoline-powered light-duty vehicles are those governing the emission of hydrocarbons, carbon monoxide, nitrogen oxide, and evaporative emissions. In this proceeding, Ethyl has shown that use of the Additive will not cause or contribute to the failure of emission control devices to meet these emission standards.[3/]

There is, by contrast, no particulate matter emission standard for gasoline-powered light-duty vehicles and trucks.[4/]

[3/] See, e.g., In Re Application for a Fuel Additive Waiver Filed by Ethyl Corporation Under § 211(f)(4) of the Clean Air Act (hereinafter "Waiver Application") (May 9, 1990) at Appendices 2A, 2B, and 2C.

[4/] Light-duty diesel vehicles must meet a particulate matter standard of 0.2 gram per mile (gpm). 40 C.F.R. § 86.087-8. Of note, not one of the EPA test vehicles came anywhere close to exceeding the 0.2 gpm particulate standard applicable to diesel

(continued...)

Indeed, no standard test method for measuring particulate emissions from gasoline-powered light-duty vehicles exists. For these reasons, particulate matter emissions are not a relevant consideration under the section 211(f)(4) criteria governing fuel additive waiver applications.

Basing a waiver decision under section 211(f) on matters unrelated to applicable emission standards would illegally circumvent the Agency's obligation under the Clean Air Act to establish by regulation "standards applicable to the emission of any air pollutant from any class . . . of motor vehicles." See CAA § 202 ("The Administrator shall by regulation prescribe . . . standards. . . .")(Emphasis added). Nothing in Title II of the Act authorizes the Agency to restrict the emission of air pollutants from automobiles absent notice and comment rulemaking initiated for the stated-purpose of establishing an emission standard. For this reason, the alleged increase in particulate

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4/ (...continued)
vehicles. Moreover, the Clean Air Act Amendments do not establish a particulate matter standard for gasoline-powered light-duty vehicles and trucks, and the EPA test cars, on average, remained well below even the stricter 0.08 gpm particulate standard for diesel vehicles contained in the Amendments.

emissions suggested by EPA's test data does not provide a basis for denying Ethyl's waiver application.[5/]

II. APPLICATION OF THE LEGAL STANDARD IN THIS PROCEEDING

A. The Record On Balance Does Not Establish that Particulate Matter Emissions to the Ambient Air Will Increase.

In evaluating the recent concern about particulate matter emissions, it is significant that the record on balance does not establish that a particulate matter emission increase will occur with use of the Additive. For example, in support of the waiver application, ECS Laboratories, a well-respected automotive testing firm, conducted numerous particulate matter emission tests on the Ethyl test vehicles. ECS Laboratories tested 23 vehicles under several different operating conditions, including the FTP driving-cycle and three different steady-state driving

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5/ Particulate matter emissions are relevant to this proceeding, if at all, only by virtue of the general purposes clause of the Act. See CAA § 101(b)(1). Under that clause, the Agency may consider the overall environmental, economic, and energy impacts of its decision, in order to ensure that its decision furthers the basic goals of the Act. See Comments in Support of the Waiver Application for the HiTEC® 3000 Performance Additive (hereinafter "Ethyl Comments")(July 23, 1990) at 7-8. If the Agency elects to consider the impact of the Additive on particulate matter emissions under the general purposes clause, however, it must also consider the significant reductions in other pollutants caused by the Additive, as well as the economic and energy benefits associated with use of the Additive. Only in this way can the Agency undertake the balancing of economic, energy, and environmental criteria contemplated by section 101(b)(1) of the Act. As discussed below, that balancing strongly supports granting this waiver application. See infra pp. 7-10.

conditions. In conducting these tests, ECS used the EPA-approved method for measuring particulate emissions from diesel-powered vehicles.[6/] The results of these tests showed that particulate matter emissions from vehicles using the Additive remained comparable to those from vehicles operating on clear fuel.[7/]

EPA, by contrast, recently conducted particulate matter emission tests on 15 cars, six of which were from Ethyl's 48-car test fleet. These tests showed an increase in particulate emissions from cars using the Additive. The configuration of the test apparatus used by EPA, however, differed significantly from the method employed by ECS, and may help to explain the difference in test results generated by the two laboratories.[8/]

Both EPA and ECS Laboratories measured manganese particulate by venting tailpipe exhaust into a tunnel and diluting the exhaust with clean air. ECS's tunnel was elevated horizontally approximately six to seven feet above ground level, and was

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[6/] As noted above, there is no approved method for measuring particulate emissions from gasoline-powered vehicles.

[7/] See Waiver Application, Appendix 3, Attachment 3-23; Supplemental Reply Comments of Ethyl Corporation to Late-Filed Comments on Public Health Effects of HiTEC® 3000 (August 23, 1990). This result is not surprising, since manganese has long been used as a fuel additive in this country and Canada without any concern regarding increased particulate matter emissions.

[8/] See Letter from John J. Adams to Mary T. Smith dated October 19, 1990, p. 4, n. 5.

connected to the automobile exhaust by means of a flexible, uninsulated hose. ECS informs us that this is the standard configuration used to conduct EPA diesel emission tests.

By contrast, the EPA tunnel was placed at ground level and connected to a test vehicle by means of an insulated pipe approximately six feet long. The EPA tunnel had a diameter of 10 inches, while the ECS Laboratories tunnel had a diameter of 18 inches. Since both EPA and ECS Laboratories used about the same volume of clean dilution air, the velocity of the air in the EPA tunnel was about 3.24 times that in the ECS Laboratories tunnel.[9/]

In an effort to evaluate further the implications of the differences in test procedures, ECS ran an additional set of particulate matter emission tests.[10/] In these tests, ECS altered the air sampler flow rate and the number of filters used to determine if these variables had an effect on measured particulate emissions. ECS found that neither of these changes had a significant impact on particulate emissions. That is, even employing a procedure more comparable to that employed by EPA,

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9/ Southwest Research Institute (SWRI), another laboratory which conducts particulate emission testing, reports that it uses a test configuration which differs from both the ECS and EPA configurations, although the diameter of the air tunnel used by SWRI is the same as that used by ECS Laboratories.

10/ A description of the additional ECS test results is enclosed as Attachment 1 to this letter.

ECS found that use of the Additive would not significantly increase total particulate emissions to the ambient air.

In sum, EPA's tests do not establish on balance that particulate emissions to the ambient air will increase with use of the Additive. Indeed, the more recent ECS testing provides further evidence that particulate matter emissions to the ambient air will not increase. For these reasons, concern regarding a potential particulate matter emission increase, even if relevant, is unwarranted, and the waiver application should be granted.[11/]

B. Even If Particulate Matter Emissions Increased As Suggested By EPA, The Increase Would Be Insignificant and Would Not Support Denial of the Waiver Application.

Even if one accepts at face value the results of EPA's recent tests, the size of the particulate matter emissions increase is insignificant and does not provide a basis for denial of the waiver application.

First, even if one assumed that every car in the nation would experience an increase in particulate matter emissions of the size observed in the EPA tests, the total increase in particulate matter emissions would still be so small that it would not significantly offset the substantial net decrease in

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[11/] In this regard, it should be noted that if the Agency wants to continue its evaluation of test methodologies for particulate matter emissions from gasoline-powered vehicles, it has authority to do so after approval of the waiver application under sections 202 and 206 of the Act.

pollution that would be experienced with use of the Additive. For example, Ethyl has estimated that use of the Additive would reduce total pollutant emissions by up to 1.67 billion pounds by 1999.[12/] If one subtracts from this amount the small increase in particulate matter suggested by the EPA data, the total pollutant reduction by 1999 associated with use of the Additive would still be about 1.56 billion pounds.[13/]

Second, the ambient impact of EPA's suggested particulate matter emissions increase would be insignificant. For example, under the Prevention of Significant Deterioration (PSD) program, EPA has identified ambient concentrations of various pollutant that it views as "insignificant" -- i.e., that are so small that they would not contribute to ambient air quality standard exceedances.[14/] For particulate matter, the concentration is 5 ug/m3 for 24-hours.[15/] If one accepts at face value the particulate matter emission increase suggested by the EPA data,

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12/ See Waiver Application, Appendix 7.

13/ The calculation is based on 141 million cars driving an average of 11,300 miles per year in 1999.

14/ See 43 Fed. Reg. 26398 (1978) ("These levels . . . are . . . interpreted by the Administrator as representing the minimum amount of ambient impact that is significant.")

15/ See 40 C.F.R. § 51.165(b) (1989)

the impact on ambient particulate levels in New York City would be well-below the 5 ug/m3 level identified by EPA.[16/]

Third, the particulate matter increase suggested by the EPA data would be an exceedingly small portion of the existing particulate matter emissions inventory. SAI predicts that such an increase would amount to less than 0.6 percent of total annual particulate emissions in the nation.[17/]

Finally, as Ethyl has previously noted, the Additive has been used for over a decade in Canada at a concentration almost twice that at issue in this proceeding. There has been no indication of concern with particulate matter emissions associated with use of the Additive in Canada during this period.[18/] The Additive has also been used in the United States in leaded gasoline in uncontrolled vehicles for over twenty-five years without any indication from EPA that use of the Additive has increased particulate matter emissions in a meaningful way.

16/ These conclusions are based on calculations performed by Systems Applications, Inc. (SAI), which are submitted as Attachment 2 to this letter. Significantly, these calculations assume that all of the particulate matter measured in the EPA tests would be emitted to the ambient air.

17/ See Attachment 2, at 3.

18/ Indeed, data showing trends in total suspended solids in Ontario, Canada from 1977 to 1987 closely parallel total suspended solid levels in the United States during the same time period even though the Additive is used in unleaded gasoline in Canada at up to twice the concentration at issue in this proceeding. See Attachment 3.

For all of these reasons, evaluation of the overall environmental impacts of the Additive strongly supports granting the waiver application, even if one assumes that the particulate matter emissions increase suggested by EPA will occur. That is, the alleged particulate matter emissions increase is so small that it does not change the conclusion that use of the Additive will entail significant environmental, economic, and energy benefits.

III. CONCLUSION

The particulate matter emission increase suggested by EPA's test data is uncertain. Moreover, even if one accepts EPA's test data at face value:

- There would still be a substantial net decrease in overall emissions of pollutants when using the Additive.
- The ambient impact of the particulate emission increase would be insignificant.
- The particulate emissions increase would be an exceedingly small portion of the existing particulate matter emission inventory.
- No particulate matter problems have been reported in Canada, where the Additive is used at a concentration almost two times higher than the concentration at issue in this proceeding, or the United States, where the Additive is used in leaded gasoline.

For these reasons, the waiver application should be approved. This is the only action consistent with both § 211(f)(4) and the overall purposes of the Act.

Sincerely,

John J. Adams
F. William Brownell
Kevin L. Fast

Enclosures

cc: Docket No. A-90-16 (by hand)
Erich W. Bretthauer (by hand)
Dr. J. Clarence Davies (by hand)
Henry F. Habicht, Esq. (by hand)
William G. Rosenberg, Esq. (by hand)

ATTACHMENT 1

PARTICULATE TEST RESULTS -- ECS LABORATORIES

Using the same particulate testing procedure described in Appendix 3 of Ethyl's Waiver Application dated May 9, 1990, ECS Laboratories has measured particulate emissions from one of the Dodge Dynasty vehicles used in Ethyl's 48-car test fleet.[1/] ECS Laboratories generated the results shown in the attached Tables 1 and 2 using two different driving cycles (the FTP and a highway cycle), and both a clear test fuel and a fuel containing 0.03125 grams per gallon as HiTEC® 3000. As shown in Tables 1 and 2, the air sampler flow rate and the number of filters used in each FTP test run varied, while only the air sampler flow rate varied for the highway test runs.

The results of these tests, which are generally consistent with earlier particulate tests conducted by ECS Laboratories, show that use of three filters generally gives slightly higher total particulate measurements than a single filter. Sample flow rate data also show very small differences in total particulate.

[1/] The original catalyst on the vehicle was replaced with a new catalyst prior to testing. The vehicle tested was a "clear fuel" vehicle in the 48-car test program.

TABLE 1

PARTICULATE EMISSION STUDY
1988 Dodge Dynasty 3.0 V-6
75,000 Miles -- New Catalyst

1975 Federal Test Procedure

DATE	Fuel	Flow Rate[2/]	Filters[3/]	Total Particulate[4/]
10-10-90	Clear	1.8 cfm	3	0.005
10-13-90	HiTEC	1.8 cfm	3	0.007
10-23-90	Clear	1.8 cfm	1	0.003
10-24-90	Clear	1.8 cfm	1	0.003
10-22-90	HiTEC	1.8 cfm	1	0.003
10-16-90	HiTEC	0.8 cfm	3	0.009
10-19-90	HiTEC	0.8 cfm	3	0.006
10-11-90	Clear	0.8 cfm	1	0.004
10-12-90	HiTEC	0.8 cfm	1	0.007
10-17-90	HiTEC	0.3 cfm	3	0.017
10-18-90	HiTEC	0.3 cfm	1	0.009

[2/] This column shows the quantity of air in cubic feet per minute (cfm) drawn through the air sampler.

[3/] The number listed represents the number of filters used to accumulate the particulate sample (i.e., either 1 filter for each sampling bag under the FTP for a total of 3 filters, or 1 filter for all three sampling bags).

[4/] The number listed is in grams per mile (gpm).

TABLE 2

PARTICULATE EMISSION STUDY
1988 Dodge Dynasty 3.0 V-6
75,000 Miles -- New Catalyst

Highway Fuel Economy Cycle

DATE	Fuel	Flow Rate[5/]	Total Particulate[6/]
10-10-90	Clear	1.8 cfm	0.051
10-23-90	Clear	1.8 cfm	0.004
10-24-90	Clear	1.8 cfm	0.004
10-13-90	HiTEC	1.8 cfm	0.018
10-22-90	HiTEC	1.8 cfm	0.004
10-11-90	Clear	0.8 cfm	0.018
10-12-90	HiTEC	0.8 cfm	0.019
10-16-90	HiTEC	0.8 cfm	0.009
10-19-90	HiTEC	0.8 cfm	0.005
10-17-90	HiTEC	0.3 cfm	0.015
10-18-90	HiTEC	0.3 cfm	0.009

5/ This column shows the quantity of air in cubic feet per minute (cfm) drawn through the air sampler.

6/ The number listed is in grams per mile (gpm).

ATTACHMENT 2

MEMORANDUM

TO: Ethyl Corporation

FROM: Ralph L. Roberson, P.E.

DATE: October 30, 1990

SUBJECT: Analysis of EPA Particulate Test Data

The purpose of this memorandum is to review emission test data that have been collected by EPA's Motor Vehicle Emissions Laboratory. EPA collected data on several vehicles (including some from Ethyl's test fleet) for particulate emissions and manganese content of particulate emissions for vehicles burning clear fuel and fuel containing manganese (Mn).

Average Particulate Emissions

The first step is to estimate average particulate emissions for vehicles burning clear fuel and for those burning fuel containing manganese. We compute average particulate emissions for each vehicle from the EPA test data.[1/] If multiple measurements were made for any vehicle, the values are averaged prior to computing a "fleet" average. Our computations are summarized in Table 1 for the New York City Cycle (NYCC) and in Table 2 for the Federal Test Procedure (FTP). We examine the FTP because it is the basis

[1/] The EPA test data were submitted to the rulemaking docket in a memorandum from David J. Kortum, EPA, dated October 22, 1990.

SYSTEMS APPLICATIONS, INC.
101 Lucas Valley Road, San Rafael, California 94903
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for compliance decisions with respect to emission standards set forth by the Clean Air Act. We examine the NYCC for use in a subsequent air quality analysis, which is based on an urban setting.

In computing averages for each vehicle, we elected to reject any subsequent particulate measurement for clear fuel once a Mn-containing additive was used. For example, Vehicle ID 8888 had one clear fuel measurement, five measurements with "104", two measurements without Mn, and one final measurement with HiTEC 3000. We used the initial measurement as a clear fuel determination, and we used the six (5+1) measurements to compute average particulate emissions for Mn-containing fuel. However, we omitted the later two clear-fuel measurements for computing clear fuel particulate emissions. That is, there may be a residual effect on particulate emissions from the use of a Mn-containing fuel.

For the NYCC, Table 1 shows that average particulate emissions for clear fuel are 0.014 gm/mi, and average particulate emissions for Mn-containing fuel are 0.037 gm/mi. The apparent increase in particulate emissions for the NYCC is 0.037-0.014 = 0.023 gm/mi.

For the FTP, Table 2 shows that average particulate emissions for clear fuel are 0.0044 gm/mi, and average particulate emissions

for Mn-containing fuel are 0.0388 gm/mi. The apparent increase in particulate emissions, based on the FTP, is 0.034 gm/mi.

Impact on Annual Nationwide Particulate Emissions

Based on the above-described analysis, we can estimate the impact on the nationwide annual particulate emission inventory. If we assume 120 million vehicles in the U.S. and an average vehicle accumulation of 11,300 miles per year,[2/] we have 1.4×10^{12} vehicle miles per year. If HiTEC 3000 results in an average increase in particulate emissions of 0.03 gm/mi (i.e., 0.023 for NYCC and 0.034 for FTP), then the nationwide annual increase is (1.4×10^{12}) (0.03) = 40.7 gigagrams per year. EPA's most recent estimate of nationwide particulate emissions is 6,900 gigagrams per year.[3/] This apparent increase in particulate emissions represents only 0.6 percent of the nationwide annual particulate emission inventory.

2/ See Appendix 7, Attachment 7-4 of Ethyl Waiver Application.

3/ Nationwide Air Pollutant Emission estimates 1940-1988, Environmental Protection Agency, Research Triangle Park, N.C., EPA-450/4-90-001, March 1990.

Impact on Ambient Air Quality

In a previous memorandum, we presented an approach for estimating the impact of Mn emissions on ambient air quality.[4/] The analysis is based on ratioing ambient CO concentrations to mobile source CO emissions. We use the same approach to estimate the potential impact on ambient particulate concentrations of an apparent increase in mobile source particulate emissions as a result of using HiTEC 3000. To use this approach for particulate emissions, we are implicitly assuming that all particulate emissions behave as gases. This results in the computation of a conservative estimate because it is likely that some fraction of the mobile source particulate emissions settle to the ground and actually do not contribute to ambient particulate concentrations.

We obtained ambient CO data from EPA's Aerometric Information Retrieval System (AIRs) for six New York City monitoring sites for 1987, 1988, and 1989. Averaging across years for the six sites, we find the following average maximum 8-hour CO concentrations: 5.5, 6.5, 9.5, 10.5, 14.2, and 15.5 parts per million (ppm). The average across the six sites is 10.3 ppm, which is equal to 12.0 mg/m^3. Using EPA's data, we estimated an apparent particulate increase of 0.023 gm/mi for NYCC test results. In the earlier memorandum, we used MOBILE4 to determine

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[4/] Memorandum from Chinkin and Roberson, Systems Applications, to Ethyl Corporation dated October 17, 1990.

an average, wintertime, New York City fleet CO emission rate of 77 gm/mi for a 7.1 miles per hour driving speed. Thus, our estimated, maximum 8-hour increase in ambient particulate concentration is given by (12.0 mg/m^3) (0.023 ÷ 77) = 3.6 ug/m^3. For a 24-hour averaging period, or if one assumes that not all particulate emissions behave as gases, the maximum increase in ambient particulate concentration would be less.

TABLE 1. SUMMARY OF EPA PARTICULATE TEST DATA OBTAINED FOR NEW YORK CITY CYCLE.

	Average Particulate Emissions (grams/mile)	
Vehicle ID	Clear Fuel	Mn-Containing Fuel
0015	0.0235	--
0018	--	0.0499
0017	0.0271	--
0016	--	0.0206
0020	--	0.0461
0019	0.0186	--
0041	0.0125	0.0526
0051	0.0127	0.0765
0024	0.0111	0.0386
0077	0.0116	0.0161
0031	--	0.0200
0021	--	0.0199
0011	--	0.0246
8888	0.0054	0.0444
0099	0.0062	0.0384
Average	0.0143	0.0373
Std. Dev.	0.0074	0.0180

TABLE 2. SUMMARY OF EPA PARTICULATE TEST DATA OBTAINED FOR FEDERAL TEST PROCEDURE.

	Average Pariculate Emissions (grams/mile)	
Vehicle ID	Clear Fuel	Mn-Containing Fuel
0015	0.0038	--
0018	--	0.0589
0017	0.0049	--
0016	--	0.0203
0020	--	0.0720
0019	0.0072	--
0041	0.0027	0.0330
0051	0.0030	0.0990
0024	0.0040	0.0306
0077	0.0064	0.0108
0031	--	0.0053
0021	--	0.0182
0011	--	0.0255
8888	0.0028	0.0574
0099	0.0049	0.0347
Average	0.0044	0.0388
Std. Dev.	0.0016	0.0277

ATTACHMENT 3

Comparison of Total Suspended Particulates in Ontario, Canada and the United States

by Ben F. Fort, Jr.
Ethyl Corporation

The attached Figure 1, shows trends for the composite averages of the geometric means total suspended particulates in the United States.[1/] I have plotted the arithmetic average (shown by "+" symbol) of the annual geometric means from Ontario, Canada.[2/] The Canadian points represent data from about 140 monitoring sites widely distributed throughout the province of Ontario (see footnote 2 for maps of the sites).

The Canadian averages closely track the U.S. data. Actual Canadian data is reproduced in Table 1 with average and standard deviations appended at the bottom of each column. Standard deviations are not reported for the U.S. data but the narrowing of the difference between the 75th and 25th percentiles (which are shown) parallel the decrease in standard deviations for the Ontario data (high of about 19 in 1978 to a low of about 12 in 1985).

The use of 1/16 gm/gallon (U.S.) of manganese in Canada has not increased the levels of total suspended particulates; indeed the values are lower than U.S. values for each year.

1/ "National Air Quality and Emission Trends Report, 1986," EPA-450/4-88 001.

2/ "Air Quality in Ontario 1987; Appendix," Environment Ontario.

Figure 1

Taken from "National Air Quality and Emissions Trends Report, 1986" EPA-450/4-88-001

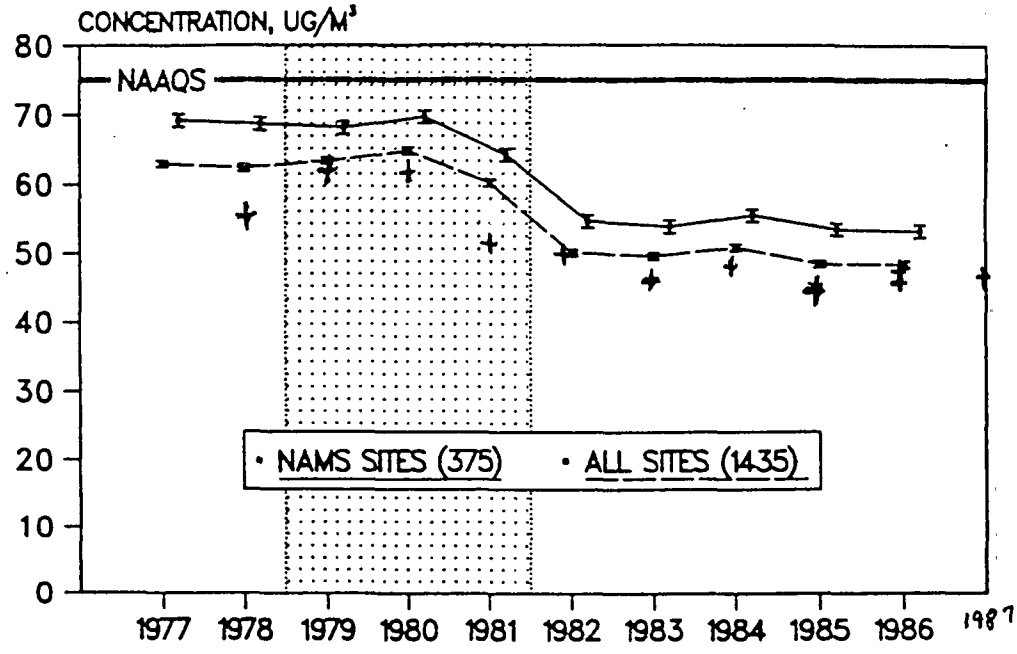

Figure 3-3. National trend in the composite average of the geometric mean total suspended particulate at both NAMS and all sites with 95 percent confidence intervals, 1977-1986.

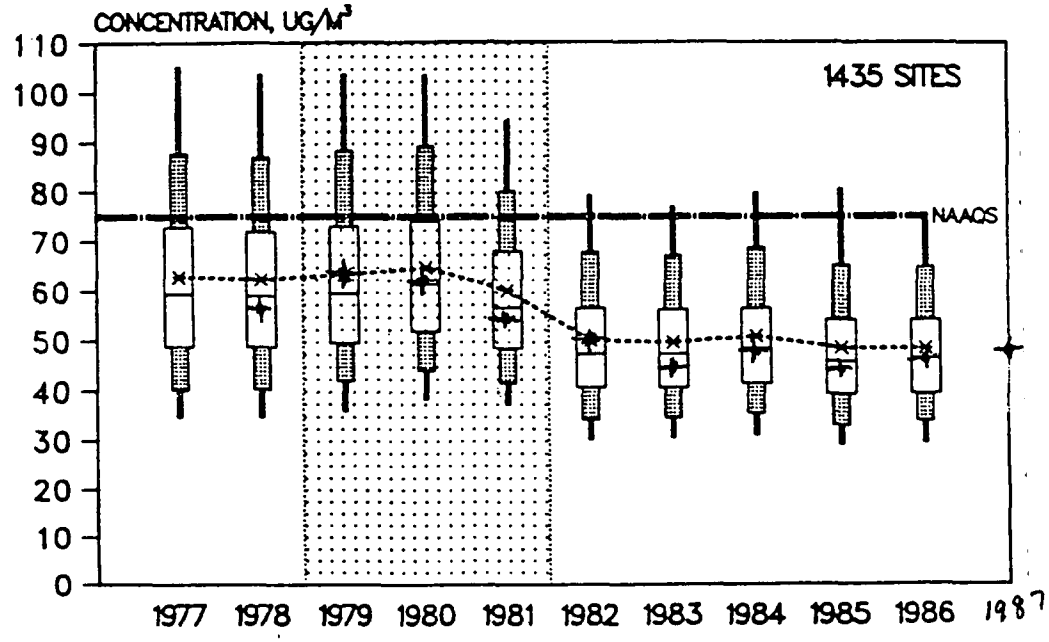

Figure 3-4. Boxplot comparisons of trends in annual geometric mean total suspended particulate concentrations at 1435 sites, 1977-1986.

+ - Corresponding year averages for Ontario, Canada.

Table 1

Table A-24 10-Year Trend for TSP (Taken from the Appendix to "Air Quality in Ontario 1987")

	Annual Geometric Mean (ug/m3)									
City	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
ATIKOKAN	28	36	39	26	20	21	23	23	22	26
BRAMALEA	57	67	60	53	61	65	66	62	59	63
CHATHAM	77	70	75	65	48	45	41	43	45	51
ETOBICOKE	71	84	83	91	74	53	59	58	61	62
FORT FRANCE S	31	39	40	39	32	33	32	26	29	29
HAMILTON	102	100	88	72	81	75	81	71	76	77
KITCHENER	68	80	64	64	54	51	58	46	56	61
LONDON	72	76	83	58	51	52	55	42	50	65
MISSISSAUGA	58	70	70	73	62	60	68	55	53	56
NORTH BAY	--	34	46	37	34	33	37	25	29	28
NORTH YORK	42	52	48	44	43	38	39	40	40	40
OAKVILLE	43	47	62	50	45	40	47	43	43	45
ORILLIA	38	50	50	44	59	42	43	42	40	41
OSHAWA	47	62	58	54	47	42	44	41	43	51
PETERBOROUG H	42	59	52	39	42	46	42	39	36	42
PICKERING	70	64	49	50	48	41	47	49	47	44
S.S.MARIE	38	53	62	45	40	35	37	36	34	35
SARNIA	80	66	76	62	58	59	45	46	45	42
SCARBORO	59	70	70	59	57	51	60	53	55	53
ST CATHARIN ES	56	67	62	57	56	68	58	50	60	--
SUDBURY	32	37	42	40	34	28	28	26	29	31
THUNDER BAY	44	51	51	52	39	35	44	36	40	35
TORONTO	67	72	67	58	55	54	54	50	51	52
WINDSOR	79	80	77	69	62	53	50	50	61	58
ARITH AVG	56.6	61.9	61.4	54.2	50.1	46.7	48.3	43.8	46.0	47.3
STD DEV	18.68	16.37	14.02	13.94	13.43	12.87	13.11	11.60	12.59	13.21